SYSTEMS FOR APPLYING COATINGS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a Continuation–in-Part of Application Serial No. 10/046,743, filed 01/17/2002, which is incorporated herein, by way of reference.

Statement Regarding Federally Sponsored Research or Development – Not Applicable

Reference to Microfiche Appendix – Not Applicable

BACKGROUND OF THE INVENTION

1. This invention is directed to systems for applying coatings to small objects, and in particular to the application of thin coatings by way of dip coating, or digital air brushing, or to transfer coatings by roller and/or pad, and to the articles thus coated. The coatings may form part of a further process, or they may be final coatings.

2. In the above-identified prior application, use is made of digital printing to apply a protective coating in the form of an "ink", which can be applied by way of a digital printing process, wherein one or more such coatings are applied. This prior process pertains primarily to planar articles; i.e. articles having a substantially planar surface to be decorated and protectively coated.

Recent progress in the Digital Ink Jet (DIJ) printing art relates to a new printhead that has been developed by Xaar in cooperation with Toshiba, which has advanced the process of DIJ printing to a stage where 'near photographic' quality is achieved. Previous print quality was limited by printheads that were incapable of producing sufficiently small ink droplets to create the necessary definition of the process colours The Xaar's 'Leopard' high performance DIJ printhead is now able to achieve eight levels of greyscale (seven sizes of ink droplet plus a 'no drop'), making it possible to achieve the quality level of print required by companies, such as for the labeling of video discs,

(DVDs). This 'near photographic' quality of print can be achieved with printing of 300 drops per inch (dpi) where with prior printheads it was achievable at 800 to 1200 dpi. The new printhead greatly simplifies the design of a DIJ printing system, as far less printheads are required, and the associated electronic hardware and software are reduced accordingly, thereby considerably reducing overall costs compared to earlier systems.

BRIEF SUMMARY OF THE INVENTION

The present article coating process may form a portion of a digital ink jet (DIJ) printing process, wherein, after applying DIJ decoration to a face of an article, a clear coating is applied by dip coating to give dishwasher and abrasion protection to the article and its decoration.

In another dip coating application, an adhesion promoting coating may first be applied to a vessel such as a drinking glass. The vessel is held in an inverted position by a vacuum mechanism, and dipped into an adhesion promoting coating solution contained in a tank, and then transferred to a small tunnel where the adhesion promoter is dried with a flow of warm air.

The still inverted vessel is then transferred to an adjacent tank and is dipped into a catalyzed, solvent based, *printable* urethane coating , and then transferred into a tunnel and held in an inverted position on spindles. It travels through this tunnel while being exposed to a flow of warm air, and heated by infrared panels or in a convection oven to flash off the solvent.

It then proceeds into a conveyorized tunnel for curing, by exposure to infrared Radiation or in a convection oven, and proceeds from there to a cooling tunnel where it is brought to ambient temperature with a flow of ambient air.

Up to this point the vessel is coated with a very thin, uniform printable coating

of almost immeasurable thickness.

The speed of this entire line is controlled such that the vessels are loaded onto the line in two second intervals and arrive at the DIJ printing machine at that same speed. The DIJ printer also is designed to print at the rate of 2 seconds per article (unit), 30 units per minute, 1800 units per hour.

After DIJ printing a conveyor transfers the product to the dip coater for a second application of transparent urethane coating and this, after repeating the same process of solvent flashing, infrared curing and cooling, is followed by inspection and packaging.

The foregoing coating steps, instead by way of dipping, may also be carried out using digitally controlled airbrushing ("DCAB").

The application of digital control to an airbrushing process permits accurate, localized application of selected coatings to discrete portions of an article.

As an alternative to dip coating, DCAB may be similarly used in coating the above-described articles, while providing the advantage of not requiring that the full surface of the vessel be coated.

Thus, in applying decoration to a drinking vessel, an adhesion promoting coating may first be applied by DCAB, being limited to the specific area to be decorated. Similarly, catalyzed, solvent based, printable urethane coating may be applied by DCAB, to condition a predetermined area of an article for the subsequent application of decoration, by whatever decorating means are selected..

Then, following the application of decorative art work to that area, the other protective coatings can similarly be applied by DCAB.

In addition to savings in coating materials, savings are also realized in reduced drying and curing requirements. These savings may also include reductions in capital cost for space and plant, as well as ongoing energy savings.

It will be appreciated that the above-described characteristics of DCAB coating also apply to its use with other forms of decoration, in addition to digitally controlled printing; e.g. coatings associated with hand-painted decoration, that convey much higher market values, on an individual basis.

In the case of planar articles such as digital video discs (DVD's) and other discs such as compact discs (CD's), the well-known printing industry FLEXOGRAPHIC (Trademark) process may be used, in which material, including coatings are applied by a sequenced group of cooperating rollers.

In FLEXOGRAPHIC transfer, a first roller picks up the coating material from a tank, transfers it to a second roller (to control the thickness of the coating) which in turn transfers the coating to a third roller having a flexible rubber cover. This third roller contacts the surface to be imprinted, and transfers the material to that surface.

In the case such as a DVD, the third roller has a transfer pad the precise size to be printed onto the DVDisc. The pad picks up the coating material from the second roller and transfers it to the DV disc.

The coating material can include light background material, such as a white undercoat, to serve as background, over which a black or colour imprint can be superimposed. Alternatively, a clear outer-coating material may be applied, to serve as protection for such coloured imprint material.

The selection of material also includes election of the coating solvent or carrier. In the case of a product where a high temperature is acceptable, an aqueous based carrier may prove suitable. Otherwise, selection of a coating based on a carrier suited to low temperature u/v curing may prove desirable or necessary.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Certain embodiments of the invention are described by way of illustration, without limitation thereto other than as set forth in the accompanying claims, reference being made to the accompanying drawings, wherein:

Figure 1 is a schematic plan view of a process line for carrying out the coating of vessels on accordance with the present invention;

Figure 2 is a schematic block diagram showing the subject process steps; and,

Figure 3 is a sketch illustrating a DCAB coated article.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figure 1, a production line 10 has a loading area 12 at which vessels are loaded onto a conveyor 14, where they are suspended from vacuum fittings in an inverted position. Each vessel is transferred to a tank 16, where it is at least partially immersed in a solution of adhesion promoter, and then passed to a dryer tunnel 18 where the adhesion promoter is dried with a flow of warm air.

The vessel then is transferred to the next tank 20, while still in the inverted position, and is dipped into a catalyzed, solvent based, urethane having from 16% to 25% solids.

The vessels then are transferred onto supporting spindles and pass into drying

tunnel 22. They travel through the tunnel 22 at a predetermined line speed while being exposed to a flow of warm air heated by infrared panels or convection, having a residence time sufficient to flash off the solvent. The warm air and solvent pass to a vent 24.

The conveyor 14 with its load of vessels then continues on into a heated tunnel 26, travelling at a predetermined speed to achieve a desired heat exposure within the tunnel 26 to cure the coating. The curing tunnel 26 is vented at vent 28.

The vessels then continue on the conveyor 14 to a cooling tunnel 30 where they are brought to ambient temperature with a flow of ambient air. At this point each vessel is coated with a very thin, uniform printable coating of almost immeasurable thickness.

The vessels now pass to a collection table 32, for passage through a printing or other decorative process. In the above-identified process, Digital Ink Jet (DIJ) printing is used, and in the present preferred embodiment DIJ printing means 34, consisting of one or more DIJ printing machines enables the application to the vessels of decoration having four or five colours.

The speed of the entire line10 is controlled, with the speed of conveyor 14 being tied to the speed of the DIJ printing means 34.

Thus, the speed of the entire line 10 is controlled so that the vessels are loaded onto the line at fixed time intervals, such as two seconds, and arrive at the DIJ printing machine at that same speed. The DIJ printer also is controlled to operate in synchronism with the coating, drying and curing portions of the process; e.g. to print at the rate of 2 seconds per article, 30 units per minute, 1800 per hour.

Leaving the printer 34, the now-printed (i.e. decorated) units travel by way of conveyor 36 to rejoin the line 10 at a location upstream of the dip coater 20, for a protective urethane coating, which is dried and cured on the line 10, and the articles taken from the collection table 32 for inspection and packaging.

For articles with which airbrush-applied (DCAB-applied) coatings are used, the required functions of the facilities are largely the same, in terms of drying and curing, but the scheduling is markedly changed, with associated cost reductions.

Turning to Figure 2, articles to be decorated are loaded onto a conveyor, at least partially immersed in a solution of adhesion promoter, then dried. Next, they are dipped into a catalyzed solvent based urethane, dried.and then cured

They are then cooled to ambient temperature.

They are then decorated by DIJ or by DCAB.

Finally, the articles are protected by way of another dip coating, then inspected and packaged.

Describing Figure 2 in more general terms:

1) adhesion promoting coating is first applied and dried

2) printable coating applied dried, cured and cooled;

3) decoration applied by DIJ or DCAB;

4) protective transparent overcoating applied and dried.

5) product inspected and packaged

Turning to Figure 3, a disc 40 is shown in three stages, A, B and C.

In stage A, a discrete area 42 receives a first, digitally controlled air brush undercoat, which is dried, and an overlying second, printable coating which is digitally airbrushed over the first, undercoat.

In stage B, an outlined area 44 contains a decoration, such as a combination of a art-work and text, superimposed on a portion of the underlying area 42, portrayed in dashed lines.

In stage C, the area 44 is overlaid by a transparent protective coating 46, which substantially coincides with the area 42 of the first and second coatings.